



FEDERAL REPUBLIC OF GERMANY  
GERMAN PATENT OFFICE  
PATENT NO. 42 38 339 A1  
(Offenlegungsschrift)

RECEIVED  
FEB 11 2004  
TECHNOLOGY CENTER R3700

Int. Cl.<sup>5</sup>: A 61 B 17/56  
Filing No.: P 42 38 339.0  
Filing Date: November 13, 1992  
Laid Open to Public Inspection: May 19, 1994

PEDICLE SCREW FOR FIXATION OF A STIFFENING ROD AND INSTRUMENT SET  
FOR ADJUSTING AND FASTENING THE STIFFENING ROD TO THE PEDICLE SCREW

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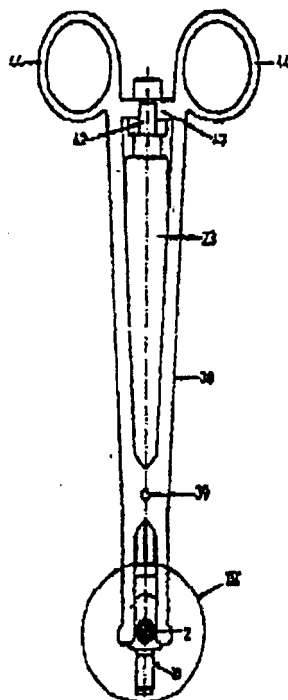
Examination request per § 44 PatG has been filed.

The following particulars are published in the version submitted by the applicant.

[Abstract]

For a pedicle screw (1) or a retaining hook for fastening a stiffening rod along the spinal column, a screw guide sleeve (10) for easing the insertion of the fastening screw during the operation is provided; said sleeve can be slipped onto screwhead (7) or the hook head such that the interior threads (14) of screw guide sleeve (10) corresponding to the interior threads (12) of

U legs (11) are aligned with the latter such that a fastening screw (13) inserted into screw guide sleeve (10) can be screwed by further turning in a guided manner into threads (14) of U legs (11).



The invention is oriented toward a pedicle screw or a retaining hook for fastening a stiffening rod along the spinal column, comprising a threaded section that can be screwed into the bone mass of a vertebra, or a hook section and a head, with an essentially U-shaped recess for inserting the stiffening rod and with interior threads on the U legs for fixation of the stiffening rod in the recess with the aid of a hex socket screw for fastening, and towards an instrument set for adjusting and fastening a stiffening rod in the U-shaped recess of the pedicle screw by means of the fastening screw.

A pedicle screw of the type constituting the present class is described in, for instance, DE 89 15 443 U1 or WO 90/09156. In the latter-mentioned pedicle screw, a cover cap is provided that serves to cover the upper end of the pedicle screw after it has been driven in.

In the first-mentioned known solution, an essential problem arises in the insertion of the screw by virtue of the fact that the stiffening rod does not come to rest in an ideal orientation in the recess between the U legs because the driven screws are not ideally aligned or forces act on the stiffening rod in order to achieve an adjusting effect. It is then extraordinarily difficult intraoperatively to drive the fastening screw into the threads, possibly against the resistance of the stiffening rod.

Starting from this point, the problem underlying the invention is to construct a pedicle screw of the type mentioned initially by virtue of an alternative conception such that an insertion of the fastening screw that substantially eases the surgeon's work becomes possible.

This problem is solved according to the invention in that a screw guide sleeve is provided which can be slipped onto the screwhead such that the interior threads of the screw guide sleeve corresponding to the interior threads of the U-legs are aligned with the latter such that a fastening screw inserted into the screw guide sleeve can be screwed by further turning in a guided manner into the threads of the U legs.

By virtue of the screw guide sleeve provided according to the invention, it is possible, preferably in conjunction with the instrument set of the invention described below, simply to slip the screw guide sleeve with the screwed-in fastening screw onto the head of the pedicle screw; from this extended position, a final positioning of the stiffening rod can then take place and, most importantly, it is possible by simply continuing to turn the fastening screw to guide it from the interior threads of the screw guide sleeve into the interior threads of the screwhead. Accordingly there is a conscious abandonment of a covering cap in the invention in favor of a considerably simplified handling in the operation.

In further elaboration of the invention, it is provided that, for the slipping on of the screw guide sleeve, the screwhead comprises a retaining section with reduced outside diameter such that the outside wall of the screw guide sleeve is approximately flush with the outside wall of the screwhead in the slipped-on state.

On two opposing sides, the screw guide sleeve can favorably comprise circular arc-shaped recesses corresponding roughly to the outside contour of the stiffening rod to be fixated.

To facilitate intraoperative handling, recesses for engagement with retaining pliers can be formed on the outside of the U-legs of the screwhead underneath the retaining section of the screw guide sleeve.

A particularly advantageous characteristic of the invention is that the U bottom of the recess has roughly a triangular cross-sectional configuration such that upon contact with the end face of the fastening screw the stiffening rod is fixated at three fastening points cross-sectionally.

This guarantees the secure holding of the stiffening rod against tilting or rotation, regardless of the relative position of pedicle screw and stiffening rod. Another essential advantage is that stiffening rods of varying diameter can be fixated reliably in every case with one and the same pedicle screw or retaining hook.

The hex socket recess of the fastening screw is advantageously formed as a through-going cutout so that a matching tool with the form of a hex key can extend through it and is thus guided in a particularly reliable way.

To achieve a wedging action and a compaction of the bone mass during insertion as the screw is driven in, it can additionally be provided that the thread section of the pedicle screw is constructed such that the envelope curve of the thread crests has an essentially cylindrical configuration, rounded off only at the bottom, while the envelope curve of the thread roots runs conically towards the bottom end of the screw.

Another advantageous characteristic consists in manufacturing the pedicle screw from titanium, so that an ultimate level of biocompatibility is assured.

The solution of the above-mentioned problem is also realized with an instrument set that is distinguished by an outer guide tube, at one end of which a retaining section is formed for inserting the screw guide sleeve together with the fastening screw threaded into it, wherein a piston rod projecting from the other end is movably arranged inside the guide tube, and wherein, at the freely projecting end of the piston rod, there is provided a rod extending parallel to the guide tube for acting on the lateral recesses of the screwhead, as well as an arrangement for longitudinal displacement of the guide tube relative to the piston rod, for pressing the screw guide sleeve against the stiffening rod and pressing the stiffening rod into the U-shaped cutout of the screwhead.

With such an instrument set, the advantage according to the invention of an easy emplacement of the fastening screw in the operation is brought to bear in a particularly favorable manner, because the adjustment of the stiffening rod is simultaneously enabled.

The arrangement for longitudinal displacement of the piston rod is advantageously constituted by a shears arrangement, one arm of the shears being connected to the outer guide tube and the other arm of the shears being connected via a longitudinal slot of the outer guide tube to the piston rod.

An additional very advantageous characteristic is that the piston rod comprises a through-going longitudinal cutout for the insertion of a hex socket screwdriver, so that this hex socket screwdriver can be inserted from the rear, engages in the recess of the fastening screw, and the latter can be screwed out of the screw guide sleeve into the immediately adjoining aligned interior threads of the pedicle screw, with the stiffening rod being simultaneously pressed into the head of the pedicle screw.

In the area of the retaining section for the screw guide sleeve, the guide tube can be provided with longitudinal slots to achieve a clamping accommodation of said sleeve.

Finally, it proves favorable to fasten the shears-like holding rod to the piston rod in a detachable form fit by means of a hook connector.

The invention will be further described below on the basis of a preferred embodiment in conjunction with the drawings. Shown therein are:

Figure 1, a section through a retaining hook according to the invention or the head of a pedicle screw according to the invention;

Figure 2, a side view in partial cross section of an instrument set for inserting a pedicle screw or retaining hook according to the invention;

Figure 3, a view rotated by 90° with respect to the representation in Figure 2;

Figure 4, a representation of detail IV in Figure 3;

Figure 5, a representation corresponding to Figure 2 to illustrate the operative situation with an inserted pedicle screw in the fixation of the stiffening rod on an adjacent retaining hook; and

Figure 6, a section through an inserted retaining hook.

In Figure 1, a pedicle screw 1 that fixates a stiffening rod 2 in the vicinity of human vertebrae is shown.

Pedicle screw 1 comprises a threaded section 3 in which the envelope curve 4 of the thread crests runs essentially cylindrically and is merely rounded off at lower end 5, while the envelope curve 6 of the thread roots runs conically towards the lower end of screw 1.

Head 7 of pedicle screw 1 comprises, as is recognizable particularly from Figure 3, a U-shaped recess 8, the bottom of which has a triangular cross-sectional configuration, so that stiffening rod 2 contacts the bottom of the recess at two points.

On the top side of screwhead 7, it has a section 9 of reduced cross section, onto which a screw guide tube 10 can be slipped.

Two legs 11, having interior threads 12 on their inner sides for a fastening screw constructed as a hex socket screw 13, are formed by recess 8 on head 7 of pedicle screw 1. Screw guide sleeve 10 also has corresponding interior threads, so that fastening screw 13 can be screwed into screw guide sleeve 10, slipped with screw guide sleeve 10 onto section 9 of reduced cross section of head 7 and then be screwed further in a guided manner.

Beneath section 9, opposing recesses 15, which enable firm engagement with appropriate curved surfaces of an instrument set to be described later, are formed on the screwhead.

Figure 2 represents a retaining hook 16, the head 7A of which is constructed identically to head 7 of pedicle screw 1, but which comprises a hook section 17 instead of a threaded section 3. The fastening of retaining hook 16 to stiffening rod 2 is done identically as for pedicle screw 1.

Figures 2-5 represent the instrument set 22 for setting fastening screw 13. This instrument set comprises an outer guide tube 23, one end 24 of which is provided with longitudinal slits 25 so as to be able to insert screw guide sleeve 10 tightly there. Screw guide sleeve 10 can in turn be slipped onto section 9 of screwhead 7 or hook head 7A. A fastening screw 13 with a through-going hexagonal cutout 26 is screwed into interior threads 12.

A piston rod 27, comprising a projection 29 passing through a slot 28 of guide tube 23; is arranged inside guide tube 23; one arm 30 of a shears arrangement 31 is fastened to said projection and can pivot about a joint 32, while the other blade 33 of shears arrangement 31 is connected to guide tube 23 so as to pivot about a joint 34. In this way, by pressing the free rear arms 35, 36 of the shears together in the direction of arrows 37 in the drawing, the guide tube can be displaced downwards in the drawing relative to the piston rod so as to press screw guide sleeve 10 onto section 9 of retaining hook 16 or pedicle screw 1.

In order to provide the necessary abutment for this pressing motion with which, on the one hand, screw guide sleeve 10 is slipped on and, on the other, stiffening rod 2 is pressed into recess 8, a second shears arrangement 38 is provided, with a central pivot bearing 39 corresponding to central pivot bearing 40 of first shears arrangement 31.

On their insides, bent front ends 41 of shears arrangement 38 comprise projecting nubs, not shown specifically in the drawing, for engagement in recesses 15. Thereby the ends 41 engage in an axially immovable manner with pedicle screw 1 or retaining hook 16. The second axial abutment is constituted by a hooked shoulder 42 of piston 27 that can be brought into engagement with a corresponding transverse bar 43. Such transverse bars 43 are placed on each blade 44 of shears arrangement 38 and provided with cross ribs, so that the mutually overlapping projections 43 interlock, forming a stable configuration.

Piston 27 has a through-going longitudinal cutout 45, through which a hex socket screwdriver can be inserted in order to drive fastening screw 13 through the interior threads 12 of screw guide sleeve 10 into interior threads 12 of pedicle screw 1 or retaining hook 16.

### Claims

1. Pedicle screw or retaining hook for fastening a stiffening rod along the spinal column, comprising a threaded section that can be screwed into the bone mass of a vertebra, or a hook section, and a head with an essentially U-shaped recess for insertion of the stiffening rod and interior threads on U-legs for fixation of the stiffening rod in the recess with the aid of a hex socket head fastening screw, characterized in that a screw guide sleeve (10) is provided that can be slipped onto the screwhead (7) or hook head (7A, 7B) such that interior threads (14) of screw guide sleeve (10) corresponding to interior threads (12) of U-legs (11) are aligned with the latter such that a fastening screw (13) screwed into screw guide sleeve (10) can be screwed in a guided manner into threads (12) of U-legs (11) by being turned further.

2. Pedicle screw according to Claim 1, characterized in that screwhead (7, 7A, 7B) comprises a section (9) of reduced diameter for the slipping on of screw guide sleeve (10) such that the outer wall of screw guide sleeve (10) is approximately flush with the outer wall of screwhead (7, 7A, 7B) in the slipped-on state.

3. Pedicle screw according to Claim 1, characterized in that, on two opposing sides, screw guide sleeve (10) comprises circular, arc-shaped recesses corresponding roughly to the outside contour of the stiffening rod (2) to be fixated.

4. Pedicle screw according to Claim 1, characterized in that recesses (15) for engagement with retaining pliers are formed on the outside of U-legs (11) of the screwhead (7, 7A, 7B) underneath the retaining section (9) of screw guide sleeve (10).

5. Pedicle screw according to Claim 1, characterized in that the U bottom of recess (8) has roughly a triangular cross-sectional configuration such that upon contact with the end face of fastening screw (13) the stiffening rod is fixated at three fastening points cross-sectionally.

6. Pedicle screw according to Claim 1, characterized in that the hex socket recess of fastening screw (13) is formed as a through-going cutout.

7. Pedicle screw according to Claim 1, characterized in that threaded section (3) is constructed such that envelope curve (4) of the thread crests has an essentially cylindrical configuration, rounded off only at the bottom, while envelope curve (6) of the thread roots runs conically towards the bottom end of screw (1).

8. Pedicle screw according to Claim 1, characterized in that pedicle screw (1) is manufactured from titanium.

9. Instrument set for adjusting and fixating a stiffening rod in the U-shaped of the pedicle screw by means of the fastening screw, characterized by an outer guide tube (23), at one end (24) of which a retaining section is formed for inserting screw guide sleeve (10), wherein a piston rod (27) projecting from the other end is movably arranged inside the guide tube, and wherein, at the freely projecting end of piston rod (27), there is provided a pliers (38) extending parallel to guide tube (23) for acting on lateral recesses (15) of screwhead (7, 7A, 7B), as well as an arrangement for longitudinal displacement of guide tube (23) relative to piston rod (27), for pressing screw guide sleeve (10) against stiffening rod (2) and pressing stiffening rod (2) into U-shaped cutout (8) of screwhead (7, 7A, 7B).

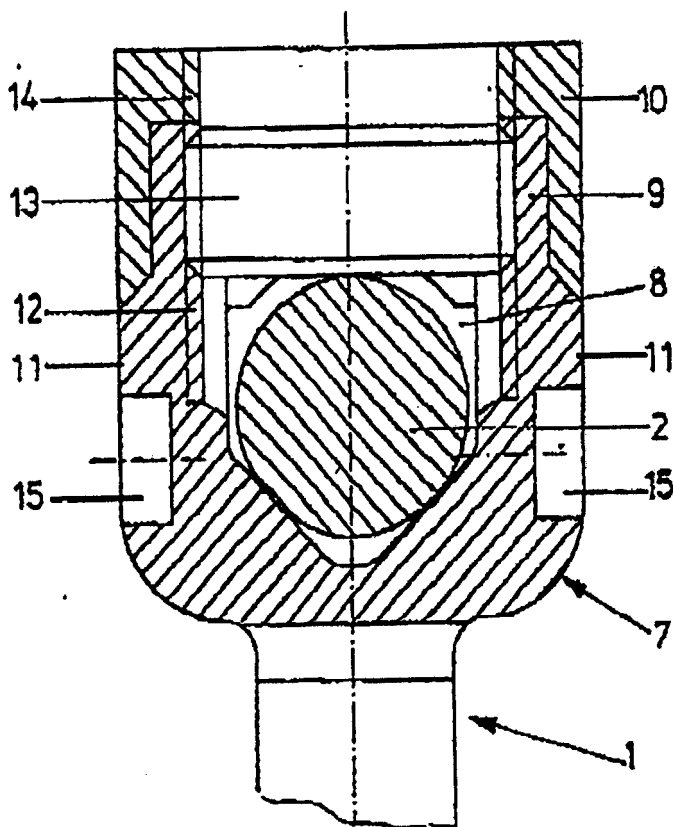
10. Instrument set according to Claim 9, characterized in that the arrangement for longitudinal displacement of the piston rod is constituted by a shears arrangement (31), one blade (30) of the shears being connected to outer guide tube (23) and the other blade (33) of the shears being connected via a longitudinal slit (28) of outer guide tube (23) to piston rod (27).

11. Instrument set according to Claim 9, characterized in that piston rod (27) comprises a through-going longitudinal cutout (45) for the insertion of a hex socket screwdriver.

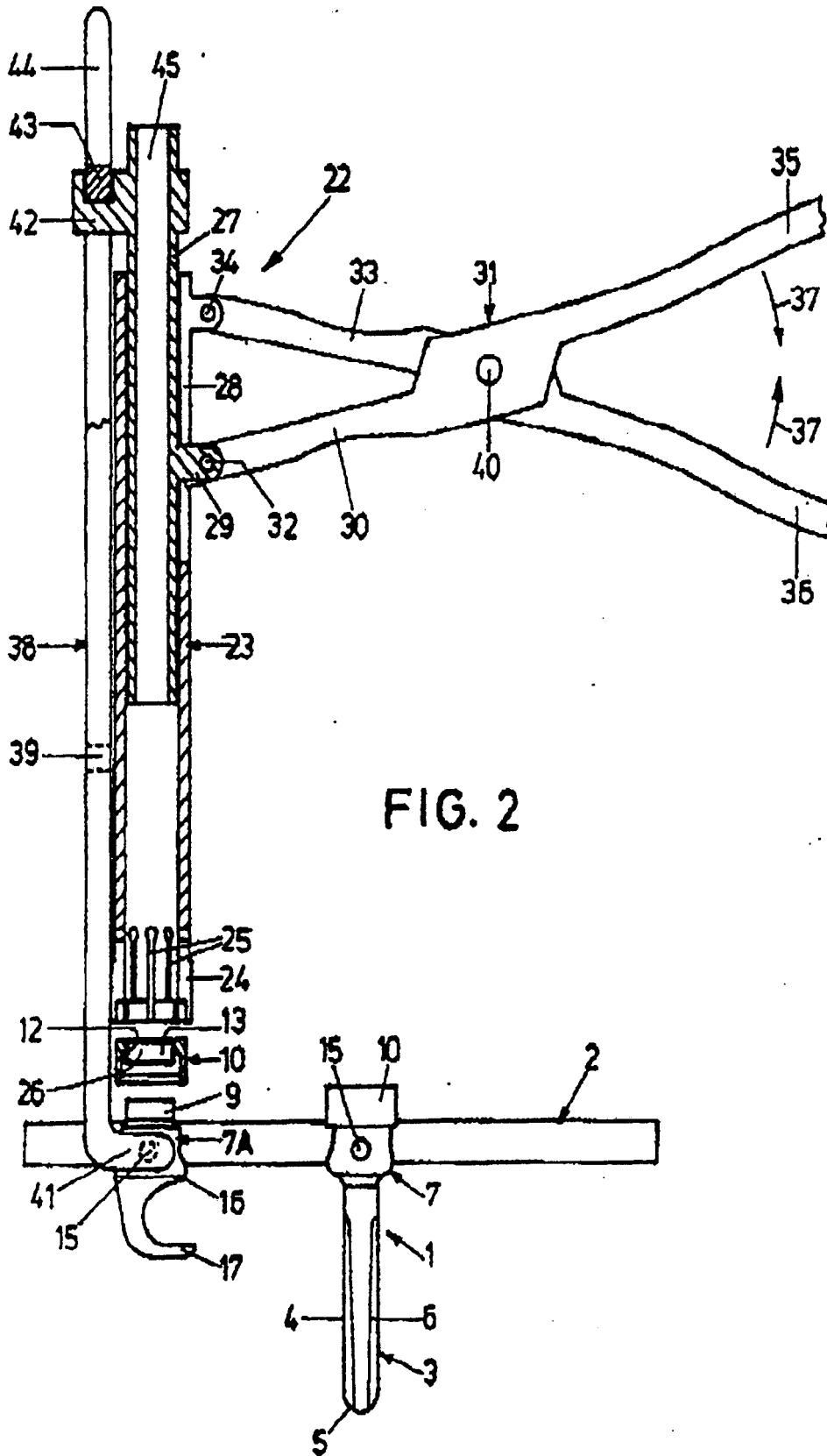
12. Instrument set according to Claim 9, characterized in that, in the area of the retaining section (end 24) for screw guide sleeve (10), guide tube (23) is provided with longitudinal slots (25) to achieve a clamping accommodation of said sleeve.

13. Instrument set according to Claim 9, characterized in that shears-like holding pliers (38) is fastened to piston rod (27) in a detachable form fit by means of a hook connector (42, 43).

FIG. 1







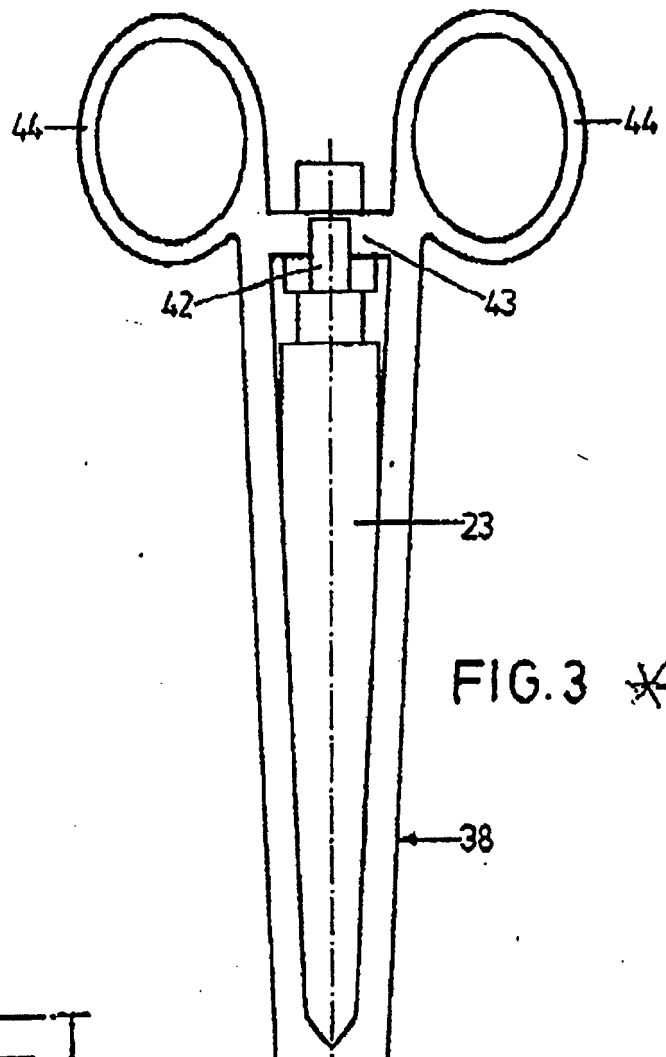


FIG. 3 \*

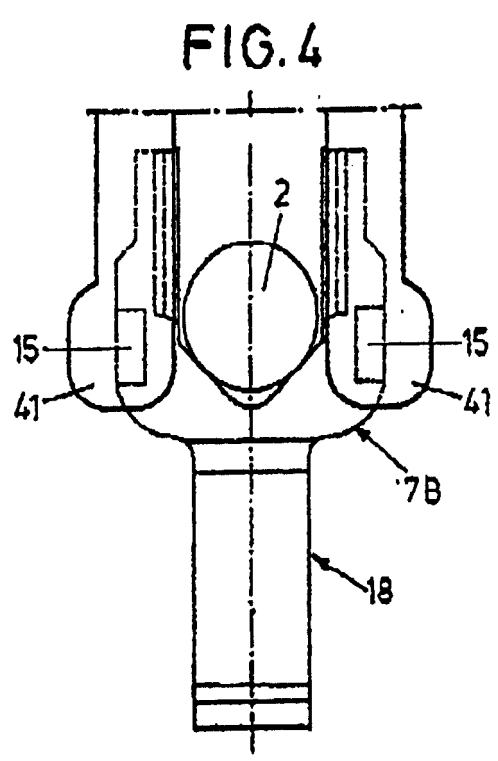
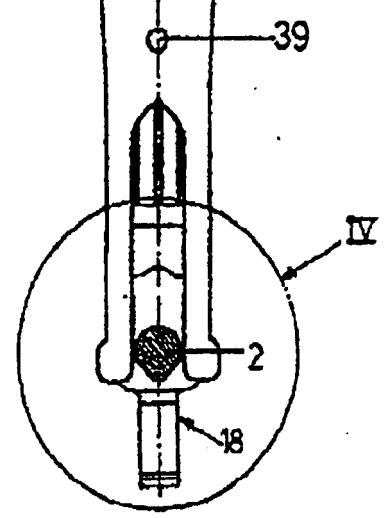
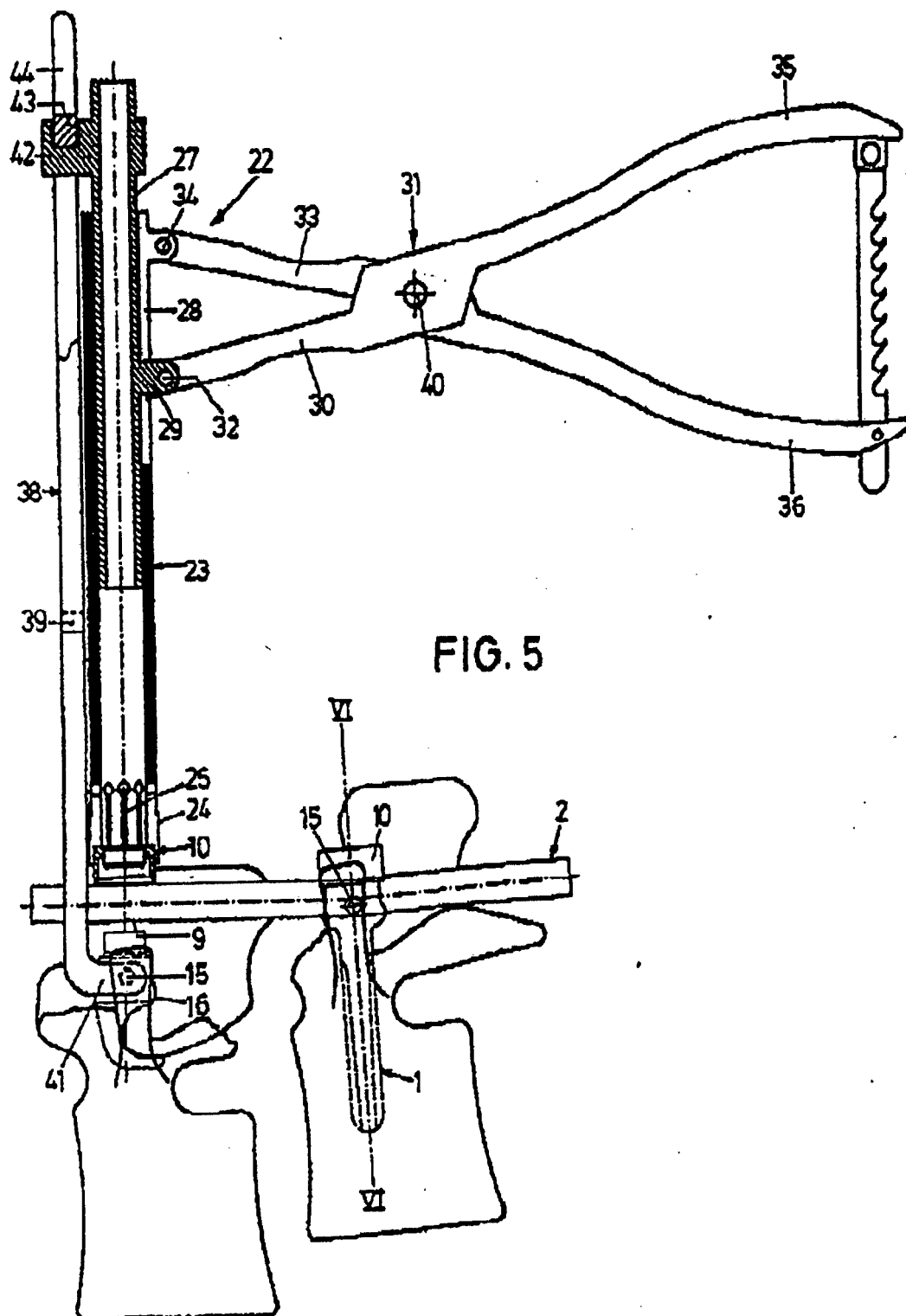


FIG. 4



IV



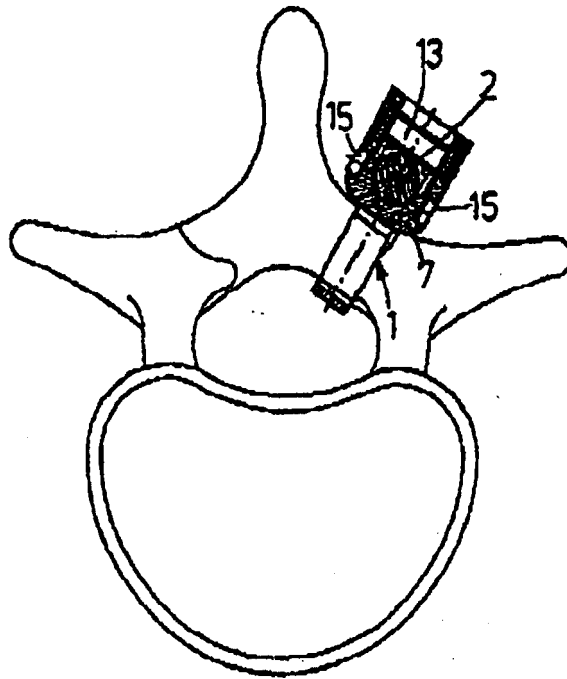


FIG. 6